Method for Splinting Rib Injuries

This application claims the benefit of provisional application 60/442,601 filed January 27, 2003.

Background of the Invention

The present invention relates to stabilizing/splinting fractures of bones, bone contusions, and sprains. More specifically it relates to the splinting of rib injuries.

Patients with blunt chest trauma are frequently seen in hospital emergency departments. Major initial concerns for the treating physician are lung collapse, which is ruled out by a chest x-ray, and other injuries that can be ruled out with a combination of physical exam and possibly other imaging studies. Once the evaluation is completed, the majority of patients are discharged home with narcotic pain medications and an incentive spirometer, a device used by the patient to monitor the volume of air inhalation during breathing. An incentive spirometer is imperative for chest wall injuries because it helps to facilitate maximal lung expansion, thereby minimizing the chance of minor lung collapse and subsequent pneumonia. With the exception of pain medication, no treatment is given to patients with rib injuries.

Splints and braces for stabilization of bony injuries and ligamentous injury are well known in the art and are used on all bony injuries except for rib injuries. Rib injuries present a unique splinting challenge due to their location. Proper splinting technique teaches that a splint should extend to include the joint on either side of the injury. Attempts have been made to follow this technique by

splinting rib injuries using a brace which wraps circumferentially around the body. However, this proves unsatisfactory because the brace significantly limits lung expansion (both lungs), is associated with high rates of post-injury pneumonia, and is uncomfortable for the patient.

Applying an inelastic adherent patch over the site of a rib injury may give temporary relief. However, it is suboptimal because the amount of reducing force applied to the fracture will be dependant on the amount of chest expansion since the adherent patch is essentially inelastic. Additionally, it is not possible to adjust the patch to optimize patient comfort after application. Showering is problematic as the adherent patch must be removed and reapplied after showering, a task beyond the skill of most patients.

It is, accordingly, an object of this invention to produce a method for splinting rib injuries which affects only the injured portion of the chest allowing unimpeded expansion of the uninjured portion of the chest.

It also an object of this invention to produce a method for splinting rib injuries which produces a reducing force at the injury site even during minimal chest expansion.

It is further an object of this invention to produce a method for splinting rib injuries which allows adjustment after application of the splinting device so as to maximize patient comfort.

It is further an object of this invention to produce a method for splinting rib injuri s in which the reducing force can be temporarily removed so as to allow

the patient to fully expand the chest during, for instance, use of a incentive spirometer, without complete removal of the splinting means.

It is additionally an object of this invention to produce a method for splinting rib injuries having means which can be removed, reapplied and adjusted by the patient for maximum comfort, for instance, for showering.

It is also an object of this invention to produce a method for splinting rib injuries which is low cost.

SUMMARY OF THE INVENTION

These and other objects are accomplished by the invention herein disclosed which is a method for splinting rib injuries that includes placing two anchor strips on the chest wall approximately equidistant from the rib injury in a more or less vertical orientation, and placing elastomeric straps across the injury in a more or less horizontal manner so as to produce a stabilizing force on the injury site, the elastomeric straps being removably affixed to the anchor strips by hook and loop fasteners. An initial tension is supplied to the elastomeric straps during placement. In this manner a reducing force is produced across the injury site regardless of the degree of chest expansion, the reducing force increasing with increasing expansion of the chest. The rate of increase in the reducing force as a function of degree of chest expansion is determined by the spring-constant of the elastomeric strap. Elastomeric straps having a low spring-constant will provide less increase in the reducing force with increased chest expansion than elastomeric straps having a higher spring-constant. By choosing the proper

combination of elastomeric strap spring-constant, and initial tension in the strap, a reducing force profile may be created which provides maximum patient comfort. Elastomeric straps with spring constants from very low (for instance, for pediatric applications) to extremely high are anticipated.

The elastomeric straps may be removed and reapplied, their placement and the amount of initial tension being adjusted after so as to maximize patient comfort. Tension in the elastomeric straps may be removed by the patient by unfastening one end from its anchor strip so that the patient can take deep breaths and use a spirometer per the physicians instructions. With minimal training, the patient can completely remove the splint including the anchor strips and reapply the splint with new anchor strips, for instance, after showering.

Other embodiments use other fastening methods for removably affixing the elastomeric straps to the anchor strips. For instance, hooks which engage the fabric of the elastomeric strap rather than pile affixed to the strap, may be mounted to the anchor strips. Or such hooks may engage a plurality of eyelets in the fabric of the elastomeric strap. Alternatively, buttons or snaps may be used.

In another embodiment a pad is placed between the elastomeric straps and the chest wall. In other embodiments this pad is a hot or cold compress. In yet another embodiment the pad is attached to a cold therapy machine.

The disclosed rib splinting method provides stabilization to the side of the rib cage having the injured ribs only. Expansion of the uninjured side is not impeded by the device. The splint provides a stabilizing force to the injury site even during minimal chest expansion, and may be adjusted after application to

maximize patient comfort. The patient can release the elastomeric strips so as to be able to take deep breaths as required and reattach them afterwards. The entire splint can be removed and reapplied by the patient for showering. The manufacturing costs of the rib splint are low due to its simple construction and the common materials used.

The more important features of the invention have been outlined rather broadly in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of a rib splint constructed in accordance with the principles of this invention.

Figure 2 is a plan view of the medial anchor strip of the object of Figure 1.

Figure 3 is an expanded sectional view of the object of Figure 2 along direction A - A.

Figure 4 is an expanded sectional view of an elastomeric strap of the object of Figure 1 along direction B - B.

Figure 5 is a perspective view of the object of Figure 1 showing the positional relationship of the device to a rib fracture during use.

Figure 6 is a plan view of an anchor strip of an anchor strip having alternate fasteners.

Figure 7 is an expanded sectional view of the object of Figure 6 along direction C - C.

DESCRIPTION OF THE EMBODIMENTS

As used herein, medial is defined as the direction toward the center of the body of a patient, and lateral is defined as the direction away from the center of the body.

Referring to the Figures, as best seen in Figure 1, Rib Splint **1** comprises a more or less vertical, medial anchor strip **2** having an upper end **4** and a lower end **5** and a lateral anchor strip **6** having an upper end **8** and a lower end **9**. Splint **1** also comprises a plurality of more or less horizontal elastomeric straps **10**, **11**, and **12** having medial ends **13**, **14** and **15** respectively and lateral ends **16**, **17** and **18** respectively, the medial ends being removably attached to medial anchor strip **2**, and the lateral ends being removably attached to lateral anchor strip **6**. Three elastomeric straps are shown, however, the actual number used will depend on the injury being treated and may be more or less.

Referring to Figures 2 and 3, medial anchor strip **2** of length **30** has a lateral edge **35** and a medial edge **36** which forms a plurality of medially extending, elongated portions **32** of length **34** spaced distance **33** apart. Elongated portions **32**, when strip **2** is applied to a chest wall, wrap partially around the curvature of the wall medially so as to give increased holding power

when the strip is subjected to a lateral force, as during use. Length **30** is approximately an integral multiple of distance **33**. As best seen in Figure 3, anchor strip **2** has a first layer **20**, formed of a compliant material such as polymeric foam, a second layer **23** formed of an adhesive material suitable for application to the skin in medical applications, and a third layer **29** having a first surface which is permanently joined to layer **20** and a second surface having a plurality of hook-shaped protrusions **28** forming fasteners suitable for removably fastening to a suitable pile fabric. Lateral anchor strip **6** is identical in construction to medial anchor strip **2**.

Referring to Figure 4, elastomeric strap **10** comprises a layer **40** formed of a suitable elastomeric material and a layer **43** forming fastener receivers formed from a pile material suitable for removably fastening to the hook-shaped protrusions **28** of layer **29** of medial anchor strip **2**. Layer 43 may extend the entire length of the strap or may only cover areas adjacent to the ends of the strap.

Referring to Figure 5, rib **51** has fracture **54**, while ribs **50** and **53** are not fractured. Rib splint **1** is applied in the following manner: the location of the fracture is determined by x-ray and/or physical examination. Anchor strip **2** is applied to the chest wall more or less vertically at a distance **56** medial to the fracture, distance **56** being determined by the attending physician, elongated portions **32** wrapping partially around the chest wall. Anchor strip **6** is applied more or less vertically a distance **57** lateral to the fracture, distance **57** being approximately equal to distance **56**, elongated portions **62** wrapping partially

around the chest wall. Medial end **14** of elastomeric strap **11** is removably affixed to anchor strip **2** near its midpoint. Elastomeric strap **11** is stretched so as to apply an initial reducing force to the injury, and lateral end **17** is removably affixed to anchor strip **6** near the midpoint of the anchor strip. In the same manner, medial end **13** of elastomeric strap **10** is removably affixed to upper end **4** of anchor strip **2**, stretched to provide an initial reducing force and lateral end **16** removably affixed to upper end **8** of lateral anchor strip **6**. Medial end **15** of elastomeric strap **12** is removably affixed to lower end **5** of medial anchor strip **2**, stretched to provide an initial reducing force and lateral end **18** removably affixed to lower end **9** of anchor strip **6**.

A medial anchor strip with alternative fasteners is shown in Figures 6 and 7. Medial anchor strip **70** is designed for use with elastomeric strips which do not have a pile fabric layer attached. It is identical in configuration and function to anchor strip 2 except that third layer **29** of strip **2** (Figure 3) with its multiple hooked protrusions, is replaced by a plurality of components **72** having a base **73** attached to second layer **74**, and a hook portion **76**. Hook portion **76** engages the fabric of an elastomeric strap, or alternatively, eyelets in the elastomeric strap.

Patient comfort may be maximized by detaching either the medial or lateral end of a elastomeric strip from its respective anchor strip and increasing or decreasing the preload reducing force. Also, the elastomeric straps may be detached and the medial or lateral end of the strap moved vertically so as to add

a vertical component to the reducing force. By trying various combinations of reducing force and reducing force direction, patient comfort can be maximized.

To do required chest expansion using the incentive spirometer, the preload in elastomeric straps **10**, **11** and **12** is released by detaching one end of each strap from an anchor strip. After completion of the expansion, the elastomeric straps are reapplied in the manner described previously.

To shower, the patient removes the entire splint including the anchor strips. After showering the splint is reapplied by the patient in the manner described previously.

In an alternate embodiment a pad is placed between the elastomeric straps and the chest wall so as to produce a stabilizing force component normal to the chest wall for added patient comfort.

In another embodiment the pad of the previous embodiment is a heated or cooled compress for enhanced pain relief, and in yet another embodiment the pad may be attached to a cold therapy machine for additional pain relief.

The described embodiments are to provide illustration of the principles of the invention only. Those skilled in the art will recognize that variations and modifications may be made to the embodiments without changing the principles of the invention herein disclosed.